illustrated in Figures 2-3. Figure 2 depicts a method of using interdigitated electrodes overlaid with dielectric material, forming blank wells into which the chemo/electro-active materials can be deposited. Figure 3 depicts an electrode screen pattern for an array of 6 materials which is printed on both sides of the substrate to provide for a 12-material array chip. Two of the electrodes are in parallel so it holds only 6 unique materials. Below that is the screen pattern for the dielectric material, which is screen printed on top of the electrodes on both side of the substrate to prevent the material from being fouled by contact with the gas mixture, such as becoming covered with soot from an auto, truck, machine or equipment engine, and shorting out. Below that is the screen pattern for the actual sensor materials. This is printed in the holes in the dielectric on top of the electrodes. When more than one material is used in the array the individual materials are printed one at a time.

The sensor materials are interconnected by conductors, and those conductors are in turn connected to electrical input and output circuitry. The circuitry includes meters, data acquisition means and other devices as appropriate to measure and record the response exhibited by a sensor material upon exposure to an analyte gas, to generate a signal in relation to that response, and to process the signals in a manner that completes the quantitative analysis of the gas mixture by presenting a report or display of a result indicating the presence and/or concentration of the analyte gas. For example, the several sensors in an array may be accessed serially by a multiplexer, and the data retrieved may then be processed on the basis of the proportionality of the value of an electrical property measured to the concentration of an individual analyte gas in a multi-component mixture. The data acquisition, processing, storage and display system may include means for conversion from analog to digital

format to enable the digitization of the responses of the sensors and other values, such as the measurement of temperature.

A response model is constructed using equations in which constants, coefficients or other factors are derived from pre-determined values characteristic of a precisely measured electrical response of an individual sensor material to a particular individual gas expected to be present as a component in the mixture to be analyzed. The equation may be constructed in an manner that takes temperature into account as a value separate and apart from the electrical responses exhibited by the sensor materials upon exposure to the gas mixture. Each individual sensor material in the array differs from each of the other sensors in its response to at least one of the component gases in the mixture, and the responses of each of the sensors to each analyte gas by itself is known.

The gas of interest to which the chemo/electro-active material will be exposed can be a single gas, a mixture, or one or more gases mixed with an inert gas such as nitrogen. Particular gases of interest are donor and acceptor gases. These are gases that either donate electrons to the semiconducting material, such as carbon monoxide, H_2S and hydrocarbons, or accept electrons from the semiconducting material, such as O_2, nitrogen oxides (commonly depicted as NO_x), and halogens. When exposed to a donor gas, an n-type semiconducting material will have a decrease in electrical resistance, increasing the current, and it, therefore, will show an increase in temperature due to I^2R heating. When exposed to an acceptor gas, an n-type semiconducting material will have an increase in electrical resistance, decreasing the current, and therefore will show a decrease in temperature due to I^2R heating. The opposite occurs with p-type semiconducting materials.

The geometry of the sensor materials, selection of material, thickness of material, and voltages used can vary and depend on the sensitivity required. The sensor materials are preferably connected in parallel in a circuit to which a voltage of about 1 to about 20, preferably about 1 to about 12, volts is applied across the sensor materials. When performing an analysis of a muti-component gas mixture, it is preferred that each chemo/electro-active sensor material in the array exhibit a different electrical response characteristic than each of the other chemo/electro-active materials in the array upon exposure to an analyte gas component of interest in the mixture.

As noted, the types of electrical response characteristics that may be measured include AC impedance or resistance, capacitance, voltage, current or DC resistance. It is preferred to use resistance as the electric response characteristic of the sensor materials that is measured to perform analysis of a component within the gas mixture. For example a suitable sensor material may be that which, when at at a temperature of about 400°C or above, has a resistivity of at least about 1 ohm-cm, and preferably at least about 10 ohm-cm, and yet no more than about 10^5 ohm-cm, and preferably no more than about 10^4 ohm-cm. Such a sensor material may also be characterized as that which exhibits, preferably at a temperature of about 400°C or above, upon exposure to an analyte in the gas mixture, a change in resistance of at least about 0.1 percent, and preferably at least about 1 percent, as compared to the resistance before exposure.

Regardless of the type of response characteristic that is measured for the purpose of analyzing the gaseous component(s) of interest, it is desirable that a sensor material be utilized for which that response value is stable over an extended period of time. When the sensor material is exposed to the analyte, the